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inner hall cell

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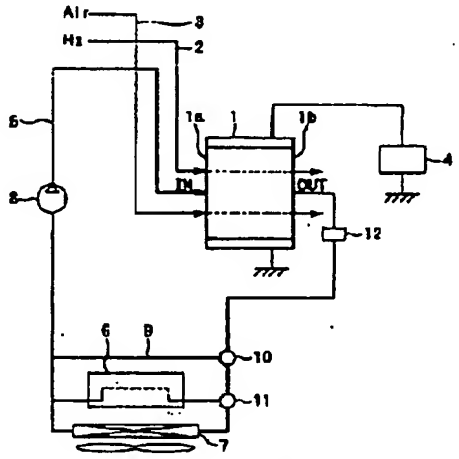
(54) FUEL CELL SYSTEM

(57) Abstract:

PROBLEM TO BE SOLVED: To provide a fuel cell system allowing the reduction of the ability of heating means required for warming up a fuel cell and restricting the irregularity of the temperature at finishing warming up.

SOLUTION: The fuel cell system comprises the fuel cell 1 for producing electric power with the chemical reaction of hydrogen with oxygen and the heating means 5 for heating the fuel cell 1 via a hot water circulated in the fuel cell 1. When the temperature in the fuel cell 1 near an inlet side 1a of a heat medium rises to a predetermined temperature for generation with the heat of the heating means 5, power generation is started near the inlet side 1a of the heat medium with the supply of hydrogen and oxygen to the fuel cell 1. The heat generated by the power generation is utilized to heat a non- temperature-rise region in the fuel cell 1 via the heat medium.



1：燃料電池　5：温水装置（加熱体装置）
2：空気通路　6：圧送用ヒータ（補助手段）
3：水素通路　12：温度センサ

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[The technical field to which invention belongs] this invention relates to the fuel cell system which manages temperature of a fuel cell (control).
[0002]
[Description of the Prior Art] The fuel cell system conventionally equipped with the fuel cell which generates electricity using the chemical reaction of hydrogen and oxygen (air) is known. For example, in the polyelectrolyte type fuel cell considered as driving sources for vehicles etc., the moisture which exists near the electrode freezes in the state of low temperature 0 degree C or less, and there is a problem that check a diffusion of reactant gas or the conductivity of an electrolyte layer falls. For this reason, in order to start operation (power generation) of a fuel cell, it is necessary to carry out warming up to the predetermined temperature which can generate a fuel cell. Then, in the conventional fuel cell system, warming up was performed by making a fuel cell circulate through heat carriers, such as warm water heated by heating meanses, such as an electric heater or a propellant formula heater, through heat carrier passage.
[0003]
[Problem(s) to be Solved by the Invention] However, heat carrier passage is formed from the inlet (IN) side of the heat carrier in a fuel cell succeeding the outlet (OUT) side, and inside a fuel cell, since a solid-state heat transfer is bad, near an entrance side carries out the temperature up of it previously. For this reason, warming up of near a heat carrier entrance side is carried out locally, and warming up [be / (cascade target) / gradual / inclination-/ it] that warming up near an outlet side is overdue happens. Therefore, in order to carry out warming up of the whole fuel cell to more than the temperature that can be generated, a long time is required upwards, excessive heater capacity is needed, and there is a problem in respect of the physique.
[0004] Moreover, as a result of performing inclination-warming up inside a fuel cell, where the temperature nonuniformity that the entrance-side temperature of a heat carrier is high, and outlet side temperature is low is formed, warming up completes a fuel cell. For this reason, at the time (at the time of initial power generation) of an initial operation of a fuel cell, it leads to a power generation distribution inside a fuel cell, and there is a problem that it is difficult to gain stable power.
[0005] this invention aims at offering the fuel cell system which can stop temperature nonuniformity at the time of a warming-up end while it reduces the capacity of a heating means required in order to carry out warming up of the fuel cell in view of the above-mentioned trouble.
[0006]
[Means for Solving the Problem] In order to attain the above-mentioned purpose, in invention according to claim 1 The heat carrier which circulates through the fuel cell (1) which is made to carry out the chemical reaction of hydrogen and the oxygen, and obtains power, and a fuel cell (1) is minded. When a temperature up is carried out to the predetermined temperature which can be equipped with a heating means (5) to heat a fuel cell (1), and can generate the entrance side (1a) of the heat carrier in a fuel cell (1) by heating by the heating means (5), Hydrogen and oxygen are supplied to a fuel cell (1), power generation is started, and it is characterized by heating the non-temperature-up field in a fuel cell (1) through a heat carrier with the heat which occurred by power generation by the heat carrier entrance side (1a).

[0007] Since warming up near an outlet side (1b) can be performed by this, stopping the fault temperature up near the entrance side (1a) of a fuel cell (1), it is enabled to perform warming up which stopped the temperature nonuniformity within a fuel cell (1) for a short time.
[0008] Moreover, in case warming up of the fuel cell (1) is carried out, even if it does not use a heating means (6) from the middle by using a fuel cell's (1)'s generation of heat own [by power generation] for self-warming up, it is enabled to heat a fuel cell (1).
[0009] Then, in invention according to claim 2, after carrying out supply start of hydrogen and the oxygen at a fuel cell (1), it is characterized by stopping heating of the fuel cell (1) by the heating means (5).
[0010] In case warming up of a fuel cell (1) is performed by doing in this way, a heating means (6) becomes possible [that what is necessary is just to heat near the entrance side (1a) of a fuel cell (1) / carrying out warming up of the whole fuel cell (1) only by the heating value which heats near an entrance side (1a)]. Therefore, the time of a heating means (6) can be held down to minimum, and a reduction of the capacity of a heating means (6), a reduction of consumption energy, and a reduction of the warm water capacity in warm water passage (5) can be aimed at further.
[0011] Moreover, in case warming up of the fuel cell (1) is carried out, the temperature gradient of the temperature near the entrance side (1a) of a fuel cell (1) and warm water temperature can be enlarged by stopping heating by the heating means (6). The heat which occurred near the entrance side (1a) thereby more effectively can be given to warm water, and warming up of a more effective fuel cell (1) can be realized.
[0012] Moreover, in invention according to claim 3, it has an electric-type heating means to heat a fuel cell (1). After supplying hydrogen and oxygen to a fuel cell (1) and starting power generation, it is characterized by supplying power to an electric-type heating means from a fuel cell (1), combining with the heat which occurred by power generation by the fuel cell (1), and heating the non-temperature-up field in a fuel cell (1) by heating by the electric-type heating means.
[0013] Thus, by the configuration, warming up of a fuel cell (1) can be more completed for a short time as compared with the case where the non-temperature-up field of a fuel cell (1) is heated only with the heat which occurred by partial power generation by the fuel cell (1). In addition, you may establish an electric-type heating means often or separately also as common with an above-mentioned heating means (6) to perform initial heating of a fuel cell (1).
[0014] In addition, the sign in the parenthesis of each above-mentioned means shows the correspondence relation with the concrete means of a publication to the operation gestalt mentioned later.
[0015]
[Embodiments of the Invention] Hereafter, the operation gestalt which applied this invention is explained based on drawing 1 . The fuel cell system of this operation gestalt applies a fuel cell to the electric vehicle (fuel cell vehicle) it runs as power. Drawing 1 is a ** type view showing the outline configuration of the fuel cell system of this operation gestalt.
[0016] As shown in drawing 1 , the fuel cell system of this operation gestalt is equipped with the fuel cell (FC stack) 1 which generates power using the chemical reaction of hydrogen and oxygen. This fuel cell 1 supplies power to the electrical machinery and apparatus 4, such as an electric motor for a run, and a battery. The fuel cell 1 of this operation gestalt uses the solid-state polyelectrolyte type fuel cell, and many cells into which the electrolyte layer was inserted by the electrode of a couple are put together, and it is constituted. Although each cell omits illustration, the cell is in the status that more than one were piled up to drawing 1 Nakagami down. It is constituted by the fuel cell 1 so that air (oxygen) may be supplied through an air duct 2 and hydrogen may be supplied through the hydrogen path 3.
[0017] As the above-mentioned technical probrem explained, since a solid-state polyelectrolyte type fuel cell cannot be generated in the state of low temperature, it needs to carry out warming up of the fuel cell 1 more than [which can be generated] temperature (for example, 0 degree C) in case of power generation. For this reason, it is constituted by the fuel cell 1 so that fluids (heat carrier), such as warm water, may circulate through the warm water passage (heat carrier passage) 5. Warm water is heated at the heater for heating 6 formed in the warm water passage 5, flows from entrance-side (IN)1a of a fuel cell 1, and flows out of outlet side (OUT) 1b (left -> right in drawing 1). Moreover,

warm water is supplied to each cell by which the laminating was carried out, respectively. As a heater for heating 6, a combustion heater, an electric heater, etc. can be used, for example.
[0018] Moreover, the bypass passage 9 which detours the heater for heating 6 and the radiator 7 is established in the warm water passage 5 in the radiator (cooling means) 7 for emitting the excessive heat which occurred by the fuel cell 1 at the time of power generation out of a system, the water pump 8 made to circulate through warm water, and warm water. Flowing of warm water is changed to the heater for heating 6, the radiator 8, or the bypass passage 9 by two cross valves 10 and 11.
[0019] Furthermore, the temperature sensor 12 for detecting fuel cell 1 outlet temperature of warm water is formed in outlet side 1b of the fuel cell 1 in the warm water passage 6. The detection temperature by the temperature sensor 12 is inputted into the control unit (ECU) not to illustrate. The control unit is constituted so that various devices, such as the heater for heating 6, the water pump 8, and the cross valves 10 and 11, may be controlled.
[0020] Hereafter, in the fuel cell system of this operation gestalt, the operation at the time of carrying out warming up of the fuel cell 1 is explained based on the flow chart of drawing 2 . First, if the starting switch (not shown) of a vehicle is thrown in, the temperature (detection temperature of a temperature sensor 12) Tw of a fuel cell 1 will be read (S100), and it will judge whether Tw is below the predetermined temperature Ts (S110). The predetermined temperature Ts is the temperature which considered predetermined additional coverage to the minimum temperature (for example, 0 degree C) which can generate electricity by the fuel cell 1.
[0021] Tw> When judged with Ts (i.e., when judged with warming up of a fuel cell 1 being unnecessary), do not perform warming up and it is ended. On the other hand, when judged with Tw<Ts (i.e., when judged with warming up of a fuel cell 1 being required), while the heater for heating 6 and the water pump 8 are started, cross valves 10 and 11 are changed and warm water is made to flow at the heater for heating 6 (S120). The warm water heated at the heater for heating 6 is supplied to a fuel cell 1 by this, and warming up of a fuel cell 1 is started (S130).
[0022] Start of warming up of a fuel cell 1 forms the inclination-temperature distribution from entrance-side 1a to outlet side 1b of warm water inside a fuel cell 1. That is, since hot warm water is supplied from entrance-side 1a, the heat of the warm water heated at the heater 6 is given near entrance-side 1a, and near entrance-side 1a serves as an elevated temperature immediately. Since heat will be taken by the time it moves to outlet side 1b from entrance-side 1a, warm water cannot heat near outlet side 1b, but is in the temperature rise near outlet side 1b. To the warm water amount of supply, since the heat capacity of a fuel cell 1 is excessive, this is produced. For this reason, although the temperature up of the entrance-side 1a of a fuel cell 1 is carried out to an instant after warm water supply start to the temperature which can be generated, near outlet side 1b will be in the status that it has not reached to the temperature which can be generated.
[0023] Here, it judges whether the temperature near entrance-side 1a of a fuel cell 1 reached the temperature (for example, 0 degree C) which can be generated (S140). After starting heating by the heater for heating 6 rather than detecting the temperature of fuel cell entrance-side 1a and starting the warm water supply to a fuel cell 1, the fuel cell system of this operation gestalt is that predetermined time passed, and is judged to be that in which fuel cell entrance-side 1a is carrying out the temperature up to the temperature which can be generated. This predetermined time can be arbitrarily set up based on the physique of the initial temperature of a fuel cell 1, the warm water flow rate which passes through the fuel cell 1 interior, and the fuel cell 1 etc.
[0024] Therefore, heating by the heater 6 is continued until predetermined time passes, after warm water supply starting to a fuel cell 1. After warm water supply start, when predetermined time progress is carried out, supply start of hydrogen and the air is carried out at a fuel cell 1 (S150). Thereby, generation of heat accompanied by partial power generation and partial power generation happens near [which is carrying out the temperature up more than / which can be generated / temperature among fuel cells 1] entrance-side 1a. Among these, the generated power is turned to an electrical machinery and apparatus 4, and the heat which occurred acts for the local temperature up near entrance-side 1a.
[0025] When the power generation status of a fuel cell 1 is detected by the electrical machinery and apparatus 4 and power generation by the fuel cell 1 cannot be detected at this time, you may constitute so that fuel cell entrance-side 1a may judge that a temperature up has not yet been carried

out to the temperature which can be generated and may return to step S130.
[0026] Next, while a cross valve 10 is changed so that warm water may flow to the bypass passage 9, the heater for heating 5 is suspended (S160). Thereby, it stops performing heating of the warm water by the heater for heating 6.
[0027] At entrance-side 1a of a fuel cell 1, although temperature tends to rise by generation of heat accompanied by power generation, the local fault temperature up near entrance-side 1a does not happen by always supplying warm water by the warm water passage 5. If warm water is supplied to a fuel cell 1, the heat which occurred near entrance-side 1a will once be given to warm water, and warm water temperature will rise. While the warm water used as this elevated temperature flows and moves to near outlet side 1b in the inside of a fuel cell 1, the heat given to warm water is given to the non-temperature-up field near outlet side 1b (S170). That is, the heat which occurred by power generation near entrance-side 1a of a fuel cell 1 will be told to outlet side 1b through the warm water which flows the warm water passage 5.
[0028] Thereby, the fuel cell 1 whole can carry out a temperature up more than [which can be generated] temperature, can complete warming up of the fuel cell 1 whole, and becomes possible [generating electricity by the fuel cell 1 whole]. Thus, when a part of fuel cell 1 reaches the temperature which can be generated, the fuel cell system of this operation gestalt starts power generation by the site which supplies hydrogen and air and serves as the temperature which can be generated, and heats the fraction (sheep temperature-up field) which does not serve as the temperature which can be generated using the heat which occurred by this power generation.
[0029] Since warming up near [which is a non-temperature-up field] outlet side 1b is performed according to the fuel cell system of this operation gestalt, stopping the fault temperature up near entrance-side 1a of a fuel cell 1, the temperature distribution within a fuel cell 1 become uniform, and can perform warming up which stopped temperature nonuniformity for a short time. It is enabled to obtain the stable power.
[0030] Moreover, in case warming up of the fuel cell 1 is carried out, even if it does not use the heater for heating 6 from the middle by using generation of heat of fuel cell 1 self by power generation for self-warming up, it is enabled to heat a fuel cell 1. That is, in case warming up of a fuel cell 1 is performed, the heater for heating 6 becomes possible [that what is necessary is just to heat near entrance-side 1a of a fuel cell 1 / carrying out warming up of the fuel cell 1 whole only by the heating value which heats near entrance-side 1a]. Therefore, the time of the heater for heating 6 can be held down to minimum, and a reduction of the capacity of the heater for heating 6, a reduction of consumption energy, and a reduction of the warm water capacity in the warm water passage 5 can be aimed at.
[0031] Moreover, like the fuel cell system of this operation gestalt, after starting power generation by the fuel cell 1 in the case of warming up of a fuel cell 1, the temperature gradient of the temperature near entrance-side 1a of a fuel cell 1 and warm water temperature can be enlarged by stopping heating of the warm water by the heater 6. The heating value of near [an inlet] 1a can be given to warm water thereby more effectively, and more effective warming up can be realized.
[0032] Furthermore, according to the fuel cell system of this operation gestalt, the purpose can be attained, without needing a new configuration equipment.
[0033] (others -- operation gestalt) in addition, although it constituted so that the power by the partial power generation by the fuel cell 1 might be supplied to the electrical machinery and apparatus 4, such as a motor for a run, after starting supply of hydrogen and air (oxygen) to a fuel cell 1, you may constitute from the above-mentioned operation gestalt so that the partial power generation not only by this but the fuel cell 1 may be used for the temperature up of fuel cell 1 self That is, the electric-type heater (electric-type heating means) which operates by the partial power generation by the fuel cell 1, and heats a fuel cell 1 is formed, the power by power generation by the fuel cell 1 is replaced with an electrical machinery and apparatus 4, an electric-type heater is supplied, and it combines with the heat which occurred by the fuel cell 1, and it constitutes so that the non-temperature-up field of a fuel cell 1 may be heated by heating by the electric-type heater.
[0034] By such configuration, warming up of a fuel cell 1 can be more completed for a short time as compared with the case where the non-temperature-up field of a fuel cell 1 is heated only with the heat which occurred by the fuel cell 1.

[0035] The electric-type heater which operates by the partial power generation by the fuel cell 1 is good also as as common as the heater for heating 6 which performs initial heating of a fuel cell 1, and the heater for heating 6 may be formed independently. In the case of the former, after it operates the heater for heating 6 which is an electric-type heater with the power from a battery etc. for initial heating and partial power generation comes to happen by the fuel cell 1, the heater for heating 6 is operated with the power from a fuel cell 1. After partial power generation comes to happen to initial heating of a fuel cell 1 by the fuel cell 1 using the heaters for heating 6, such as a combustion heater, in the case of the latter, the heater for heating 6 is suspended, and an electric-type heater is operated in it.

[0036] Moreover, although it judged whether near entrance-side 1a of a fuel cell 1 would have reached the temperature which can be generated with the above-mentioned operation gestalt based on the elapsed time after heating start of the warm water by the heater for heating 6, a temperature sensor may be prepared in entrance-side 1a of not only this but the fuel cell 1, and you may judge based on the temperature detected by this temperature sensor.

[Translation done.]

* NOTICES *

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DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is the ** type view showing the outline configuration of the fuel cell system of the above-mentioned operation gestalt.
[Drawing 2] It is the flow chart which shows an operation of the fuel cell system of the above-mentioned operation gestalt.
[Description of Notations]
1 [-- A hydrogen path, 5 / -- Warm water passage (heat carrier passage) 6 / -- The heater for heating (heating means), 12 / -- Temperature sensor.] -- A fuel cell, 2 -- An air duct, 3

[Translation done.]

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CLAIMS

[Claim(s)]
[Claim 1] The heat carrier which circulates through the fuel cell (1) which is made to carry out the chemical reaction of hydrogen and the oxygen, and obtains power, and the aforementioned fuel cell (1) is minded. When a temperature up is carried out to the predetermined temperature which can be equipped with a heating means (5) to heat the aforementioned fuel cell (1), and can generate near the entrance side (1a) of the aforementioned heat carrier in the aforementioned fuel cell (1) by heating by the aforementioned heating means (5) The fuel cell system characterized by heating the non-temperature-up field in the aforementioned fuel cell (1) through the aforementioned heat carrier with the heat which supplied hydrogen and oxygen to the aforementioned fuel cell (1), started power generation near [aforementioned] the heat carrier entrance side (1a), and occurred by the aforementioned power generation.
[Claim 2] The fuel cell system according to claim 1 characterized by stopping heating of the aforementioned fuel cell (1) by the aforementioned heating means (5) after carrying out supply start of hydrogen and the oxygen at the aforementioned fuel cell (1).
[Claim 3] After having an electric-type heating means to heat the aforementioned fuel cell (1), supplying hydrogen and oxygen to the aforementioned fuel cell (1) and starting power generation, The fuel cell system according to claim 1 or 2 characterized by supplying power to the aforementioned electric-type heating means from the aforementioned fuel cell (1), combining with the heat which occurred by power generation by the aforementioned fuel cell (1), and heating the non-temperature-up field in the aforementioned fuel cell (1) by heating by the aforementioned electric-type heating means.

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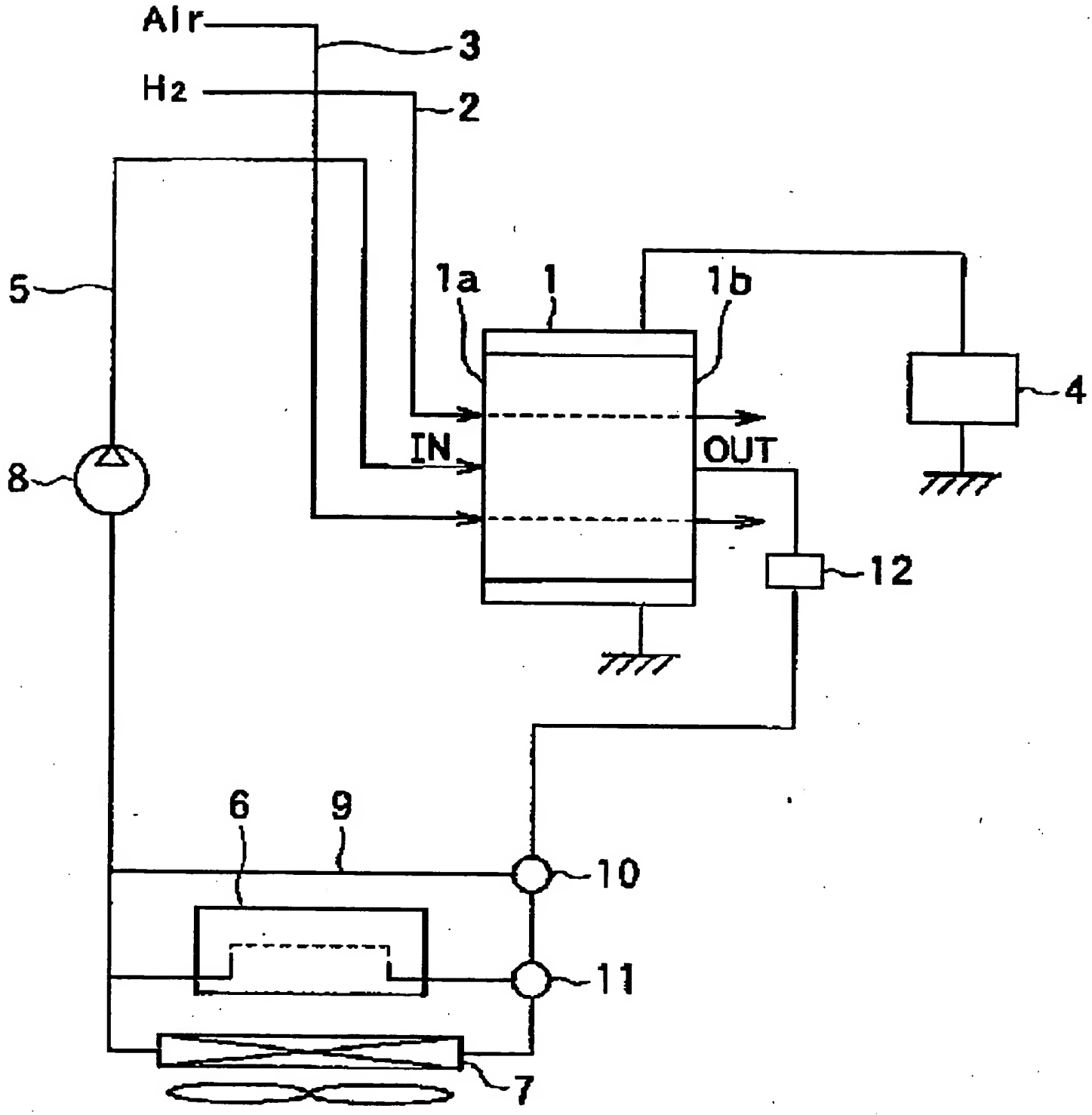

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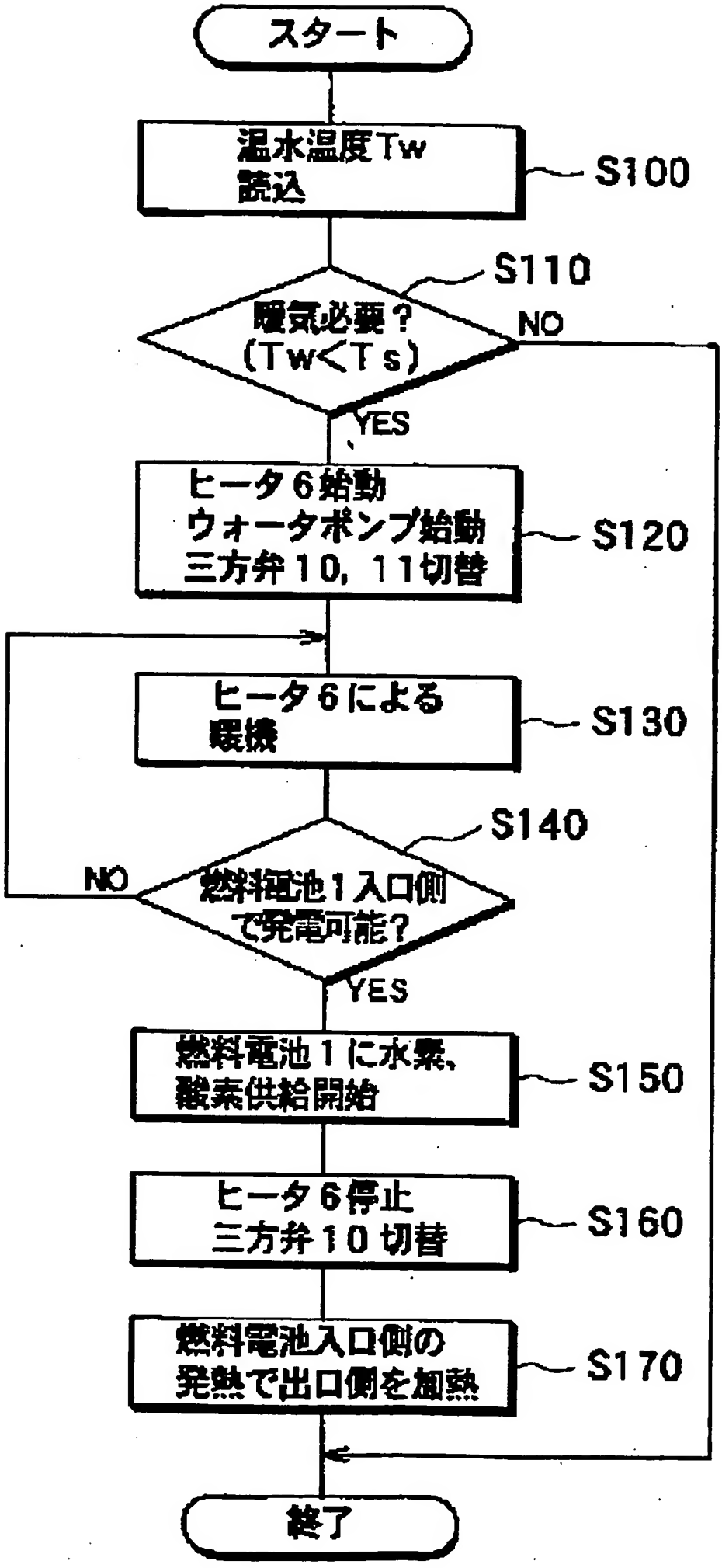
スタート
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S110
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(Tw<Ts)
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ヒータ6始動
ウォータポンプ始動
三方弁10，11切替
S120
ヒータ6による
暖機
S130
S140
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で発電可能？
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ヒータ6停止
三方弁10切替
S160
燃料電池入口側の
発熱で出口側を加熱
S170
終了